3,595,302 to Mallener; claims 1, 2 and 9 stand rejected as allegedly unpatentable over GB 2,177,331 to Makelainen; claims 1, 2 and 9 stand rejected as allegedly unpatentable over the English language abstract of Japanese Patent No. JP 59-133940 and claims 6-7, 12 and 14-15 stand rejected as allegedly unpatentable over a combination of the above-cited references.

Objection to Drawing

The Examiner objects to the drawings for allegedly failing to show the meniscus as described in the specification. Applicants advise counsel that the meniscus is identified in FIG. 1 as the bath surface 3, which is the horizontal line 3 that runs up to the elevation at which the molten steel contacts the mold during casting. To further point out and distinctly claim this feature, the claims have been amended to identify the meniscus region as the horizontal line 3 in FIG. 1.

Reconsideration and withdrawal of the objection are respectfully requested.

Claim Objection

In view of the amendments made herein, it is respectfully submitted that the claim objections are now overcome. Reconsideration and withdrawal of the objections is respectfully requested.

Claim Rejection Under 35 U.S.C. § 112, Second Paragraph

It is respectfully submitted that the amendment entered herein overcomes the rejections under 35 U.S.C. § 112, second paragraph.

Responsive to the Examiner's rejection of the terms "other areas" and "the remainder of the surface", the claims have been amended to particularly point out and distinctly claim

Applicants' invention. It is respectfully submitted that in view of the amendments made herein, an ordinary skilled artisan reading the specification would readily understand the scope of the claims.

The Examiner's reconsideration and withdrawal of the § 112, second paragraph, rejections are respectfully requested.

Claim Rejection Under 35 U.S.C. § 103(a)

A. Rejection over Grove

Applicants respectfully submit that independent claim 1 is not obvious over Grove. This reference alleges a mold liner for continuous casting of metals with a cooling structure for selectively cooling the mold liner assembly such that cooling is directed in varying intensities to different portions of the inner surface of the mold liner assembly. See col. 2, lines 10-14. (Emphasis added.) Grove does not teach any quantitative limitations on the difference in the hear flow rate between the meniscus and other portions of the their mold liner. In contrast, claim 1 recites quantitative limitations on the difference in rate of heat flow between different portions of the mold. Applicants respectfully submit that Grove does not render the invention of claim 1 unpatentable because, among others, the reference fails to disclose or suggest that surface related heat flow in the more stressed areas of the bath surface is within the specific range of 5-40% greater than in other areas of the bath surface.

Moreover, Applicants' claimed range is critical as is explained throughout the specification. Referring, for example, to page 1, lines 16-33, Applicants disclose that the conventional casting dies aim to provide homogeneous cooling of the casting surface even at the critically stressed regions of the die. One such method is varying the cooling rate or the geometry of the cooling channels. See, e.g., page 2, lines 26-28. However, Applicants' destructive test of numerous die plates show varying weakening of the surface of the die and of the area extending near the meniscus. At page 3, lines 3-5, the specification discloses that the hardness value undergoes a considerable change throughout the life of the die. Accordingly,

Applicants claimed recitation (*i.e.*, "the casting die body (1) has a cooling zone in the meniscus region (3) with a heat flow rate of 5-40% greater than the heat flow rate in adjacent regions of the casting die body (1)") is critical and not obvious over Grove.

For these reasons Applicants respectfully request reconsideration and withdrawal of the obviousness rejection of claim 1 over Grove.

B. Rejection Over Villanueva

Independent claim 1 is also not obvious over Villanueva. The reference alleges a funnel-type ingot mold having a cooling optimized area (col. 2, lines 4-5) made-up of, *e.g.*, triangular shaped depressions. Villanueva also alleges that the geometry of the depressions is uniform over the cooling optimized area. *See, e.g.*, Villanueva, col. 2, lines 2-29. The reference does not teach varying the dimensions (*e.g.*, depth) or geometry of the depressions to achieve specific quantitative differences in heat flow rate between specific cooling zones or between different portions. Furthermore, the reference does not disclose nor suggest the specifically-claimed range of 5-40% as recited in claim 1. Therefore, Applicants respectfully request reconsideration and withdrawal of the obviousness rejection of claim 1 over Villanueva.

C. Rejection Over Stagge (WO 97/43063)

Turning to the English language translation of Stagge (WO 97/43063), Applicants respectfully submit that this reference also fails to render claim 1 unpatentable. Stagge is directed to a liquid-cooled mold for strand casting thin iron slabs wherein the copper plates are fastened to the supporting plate via metal bolts. Stagge alleges that the stainless steel bolts connecting the copper plate to the supporting plate are disadvantageous as they weld poorly to the copper plate. The reference adds that the problems is caused by the different grain type/size in the bolt material and the plate material. To overcome this problem, Stagge discloses selectively molding metal bolts of a mold body from a CuNiFe alloy to increase stability of the

welded joints with the copper plate. See, *e.g.*, Stagge at page 3, lines 3-6. Stagge does not disclose or suggest raising the heat flow rate in meniscus, let alone at the specifically claimed rates of 5-40%. Indeed, Stagge does not even recognize the problem contemplated by Applicants. For at least theses reasons, Applicants respectfully submit that Stagge fails to render claim 1 unpatentable. Reconsideration and withdrawal of the obviousness rejection over Stagge is respectfully requested.

D. Rejection Over Euler

Applicants respectfully submit that independent claim 1 is not rendered unpatentable by Euler. The reference is directed to a mold for continuous casting of rounds or billets. In particular, Euler alleges providing a tubular envelop around the mold "with cooling grooves extending predominantly in longitudinal direction and being arranged on the side facing away from the liquid content of the mold." Col. 1, lines 64-67. In the embodiment of FIG. 3 and the portions cites by the Examiner (col. 4, lines 3-21), the reference alleges mold 2 having v-shaped grooves 16 formed therein. The base of grooves 16 face the surface being cooled. The Examiner states, and the Applicants agree, that Euler fails to disclose or suggest providing a cooling zone in the meniscus region with a heat flow rate of 5-40% greater than the heat flow rate of the adjacent regions. As explained in reference to the Grove, the criticality of this range is evidenced in that the conventional molds show drastic fluctuation in hardness value after extended application. Accordingly, Applicants respectfully submit that Euler does not render invention recited in claim 1 unpatentable and respectfully request the Examiner's reconsideration and withdrawal of the obviousness rejection.

E. Rejection Over Mallener

Applicants respectfully submit that claim 1 is patentable over U.S. Patent No. 3,595,302 to Mallener. At col. 1, lines 27-31, the reference discloses: "it is believed that for the most effective casting the greatest amount of heat should be abstracted from the upper portions of the mold cavity . . . ." Emphasis added. Referring to FIG. 4, the references discloses: "grooves 16b

and 16b' are at the upper portions of the interfaces 15b between the mold plates 11b and backing plates 12b and have different cross-sectional dimensions and different depth, to provide thinner mold plate walls . . . " Thus, Mallener alleges removing heat from the upper portions of the mold cavity. The reference does not disclose or suggest providing cooling zone in the meniscus region with a heat flow rate of 5-40% greater than the heat flow rate of the adjacent regions of the casting die body. The reference also fails to appreciate the criticality of the 5-40% range as relating to hardness of the die during prolonged application. For these reasons, Mallener fails to render the invention of claim 1 unpatentable. Applicants respectfully request reconsideration and withdrawal of the obviousness rejection of claim 1 over Mallener.

F. Rejection Over Makelainen

U.K. Patent Application No. 2 177 331 to Makelainen concerns a continuous casting mold. At page 1, lines 22-26, the reference discloses that "the most intensive thermal strain is directed on the mould wall in the region where the boundary of molten metal fluctuates during the casting operation, as well as in the immediate vicinity of the said region." The reference alleges improving *heat transfer capacity* of the mold wall as it discloses at page 1, lines 88-93: "heat transfer capacity of the mould wall can be regionally improved by providing the outer circumference of the mould with grooves, the longitudinal direction whereof is roughly parallel to the central direction of the mould." The reference fails to render the embodiment of claim 1 unpatentable for at least the reason that it fails to disclose or suggest having a cooling zone in the meniscus region, let alone providing 5-40% greater heat flow rate than the heat flow rate of the adjacent regions.

Applicants respectfully request reconsideration and withdrawal of the obviousness rejection of claim 1 over U.K. Patent Application No. 2 177 331 A.

G. Rejection over JP 59-133940

Finally, Applicants respectfully submit that JP 59-133940 does not render the claimed invention unpatentable. Referring to FIG. 2, the English language translation of the abstract

alleges "the cooling power of a short side copper plate 2 using cooling water is changed in accordance with the change in thermal load in the vertical direction in a casting billet." The reference adds that the passage of speed of cooling water as well as the depth and length of slit 3 (FIG. 2), among others, can be adjusted to maintain a uniform temperature.

This reference suffers from the same inadequacy as the above-cited references. Namely, the English Language translation as well as Figures 1-8 fail to render the embodiment recited in claim 1 obvious because they do not disclose nor suggest the providing 5-40 % greater cooling rate in the meniscus. In fact, the English language translation seems directed to the "short side copper plate 2". It is not readily clear whether the so-called "short side copper plate" is in fact a thermally and mechanically stressed area, let alone whether this area is supplied with 5-40% greater cooling rate than the adjacent areas.

For these reasons, it is respectfully submitted that the claimed invention is patentable over JP 59-133940. Applicants respectfully request reconsideration and withdrawal of the obviousness rejection of claim 1 over this reference.

H. Rejection of Dependent Claims

At paragraphs 16 and 17, the Examiner rejects dependent claims 6-7, 12-14 and 15 as allegedly unpatentable over a combination of references. Because each of these and other dependent claims depend from independent claim 1, which as explained is deemed to be patentable, additional reasons for patentability of the each of the dependent claims will not be proffered here. Reconsideration and withdrawal of the dependent claims' rejection are respectfully requested.

CONCLUSION

In view of the foregoing, reconsideration and allowance of this application are now believed to be in order, and such action is hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, he is kindly requested to contact the undersigned at the telephone number listed below.

Applicants hereby request that the Office charge any appropriate extension of time fee which may be required to maintain the pendency of this case, and any other required fee, except for the Issue Fee, to Deposit Account No. 11-0600.

Respectfully submitted,

Date: July 18, 2003

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

1. (Amended) A liquid-cooled casting die for a continuous billet casting comprising:

a form-giving casting die body (1), ~~made of a material of high heat conductivity,~~ having at least one broad side wall ~~having at least one surface, a part of which defines a meniscus, the casting die body having~~ with a pouring ~~side~~ surface for receiving molten metal and defining a meniscus region (3) and a cooling-surface ~~side, which cooling surface side is~~ in contact with a cooling bath, the pouring-surface and the cooling-surface defining a thickness,

wherein the casting die body (1) has a cooling zone in the meniscus region (3) ~~thermally and mechanically stressed areas of the die body, the mold surface in said cooling zone having~~ with a ~~rate of~~ heat flow rate of 5-40% greater than ~~that~~ the heat flow rate in ~~the remainder of the surface~~ adjacent regions of the casting die body~~providing (1) increased cooling rate in the critically stressed areas of the casting die~~.

2. (Amended) The casting die body (1) as recited in claim 1, wherein the form-giving casting die body is made of copper or a copper alloy.

3. (Amended) The casting die body (1) as recited in claim 1, further comprising a die cavity (2) ~~having~~ defined by two broad-side walls situated opposite each other and two narrow-side walls, ~~limiting the width of the billet~~ the narrow-side walls forming a cross-section of the die cavity; said broad-side walls connected to a base and forming the meniscus ~~thereon~~ region (3).

4. (Amended) The casting die body (1) as recited in claim 3, wherein the cross-section of the die cavity (2) at a first end is greater than at a second end.

5. (Amended) The casting die body (1) as recited in ~~claim 3~~ claim 4, wherein the broad-side walls further define a funnel running from ~~the die cavity at~~ the first end ~~has at least one hollow space which becomes smaller in the direction of~~ to the second end.

6. (Amended) The casting die body (1) as recited in claim 1, wherein the cooling zone ~~having a greater surface-related heat flow is arrange in a bath surface area, the cooling zone extending~~ extends to cover an area that is at least 20% more than ~~of the length of the~~ a width of the meniscus region (3)~~of the broad side wall~~.

7. (Amended) The casting die body (1) as recited in claim 6, wherein the cooling zone ~~having a greater surface-related heat flow is arranged in a bath surface area, the cooling zone extending~~extends to cover an area that is 30-60% more than ~~of the length of the~~ a width of the meniscus region (3)~~of the broad side wall~~.

8. Cancelled.

9. (Amended) The casting die body (1) as recited in claim 1, wherein the rate of heat flow in the cooling zone is 10-20% greater than ~~in the other areas of the bath surface~~ the heat flow rate in adjacent regions of the casting die body (1).

10. (Amended) The casting die body (1) as recited in claim 1, wherein the ~~wall~~ thickness separating the pouring-surface ~~side~~ from the ~~bath~~ cooling-surface is reduced in the meniscus region (3)~~thermally and mechanically stressed areas of the broad side walls~~.

11. (Amended) The casting die body (1) as recited in claim 10, wherein the ~~wall separating the pouring side and the cooling surface side of the bath surface area has a~~ thickness ~~that~~ is reduced by 1 to 6 mm in the meniscus region (3)~~compared to the wall thickness in other areas~~.

12. (Amended) The casting die body (1) as recited in claim 1, ~~wherein the casting die body, in a direction running parallel to the direction from the first end to the second end, further~~ wherein the cooling surface comprises a plurality of ~~at least one groove-shaped coolant channel or cooling bore holes~~cooling channels (4) having a depth (6), the depth of the cooling channels being ~~spacing between which is~~ at least 20% ~~less in~~ more (d2) in the ~~thermally and mechanically stressed areas~~ meniscus region (3) than ~~it is in horizontally~~ the adjacent areas (d1).

13. Cancelled.

14. (Amended) The casting die as recited in ~~claim 23~~ claim 12, wherein the cooling ~~coolant~~ channels ~~or the cooling bore holes~~ become gradually narrower in ~~are arranged in~~ a transitional area (C)~~so as to become gradually narrower~~.